REMARKS

(1) Claims 1-3 and 5-31 are pending in this application. Claim 31 has been added in this Response. The limitation of claim 31 is found in claim 13. Although claim 31 is added, the scope of claim 31 is the same as claim 13. Thus, the amendment should be entered.

(2) Claims 1-3 and 5-30 were rejected under 35 U.S.C. §103(a) as being unpatentable over Ishibashi et al. (U.S. Patent No. 6,579,657) in view of Forsberg (US Patent No. 4,661,275 or 4,749,500) or Markovich et al. (U.S. Patent No. 5,055,342).

(i) The Applicants previously argued that Ishibashi et al. did not possess any resist pattern thickening material capable of thickening a resist pattern of ArF resist, and that the disclosure of "ArF" in Ishibashi et al. at col. 6, line 46 is not enabling.

The Examiner replies that "the examiner does not agree that the disclosure of ArF is not enabling," and that "the citation in column 6 seems to state that the material is capable of being exposed to ArF despite applicants' statement that it does not," and "absent evidence to the contrary, it is the position of the examiner that when the surfactant of either of the secondary references is employed as the surfactant in Ishibashi, the resultant material would thicken the [ArF] resist pattern." Page 4 of the outstanding Office Action.

(ii) Although the Applicants presented the evidence to show that the Ishibashi's material could not thicken an ArF resist, the Examiner seems not to have considered the evidence as previously presended. Three references (Items (a)-(c) *infra*) were previously submitted, and argued. IDS and Response filed on July 6, 2007. The Applicants herewith point out there additional references (Items (d)-(f) *infra*) to further support the Applicants' argument that the material disclosed by Ishibashi et al., that is RELACS, could not thicken an ArF resist.

(d) US Patent No. 6,486,058

US Patent No. 6,486,058 was filed on October 4, 2000 by Jun-Sung Chun. The invention was assigned to Integrated Device Technology, Inc. Jun-Sung Chun states as follows:

> More recently, Mitsubishi and Clariant developed contact hole shrinking methods, called RELACS (Resolution Enhancement Lithography Assisted by Chemical Shrink), which is described in an article by Takashi Kanda et al, entitled "100 nm Contact Holes Using Resolution Enhancement Lithography Assisted by Chemical Shrink," Microlithography World, Autumn 1999.

Col. 2, lines 20-26 of US Patent No. 6,486,058. Emphasis added. One skilled in the art, like Jun-Sung Chun, understood that the RELACS technology is developed by Mitsubishi and Clariant, which is describe in an article by Takashi Kanda. Note that the Ishibashi reference (U.S. Patent No. 6,579,657) was assigned to Mitsubishi Denki Kabushiki Kaisha, and that the Kanda reference (JP 2001-019860) was assigned to Clariant Internatl Ltd., and Takashi Kanda is an inventor of the Kanda reference (JP 2001-019860). The Kanda reference (JP 2001-019860) was previously cited in the present application, but the Examiner has withdrawn it. US Patent

No. 6,486,058 supports that RELACS is the technology developed by Takashi Kanda et al. and owned by Mitsubishi and Clariant.

(e) US 2007/0197014

This application was filed by Jin-ho Jeon; Cha-won Koh; Yun-sook Chae; Gi-sung Yeo; and Tae-young Kim. This application was assigned to Samsung Electronics Co., Ltd. This application was filed in the U.S. on February 6, 2007, claiming a foreign priority of a Korean application filed on February 17, 2006. The inventors of this application states as follows:

> [0005] With increases in the integration density of semiconductor devices, the width of a contact that connects a lower conductive layer and an upper interconnection decreases. A pitch between contact hole patterns also decreases. To reduce the size of a contact hole pattern and a pitch between contact hole patterns, thermal reflow, resolution enhancement of lithography by assist of chemical shrinkage (RELACS), shrink assist layer for enhanced resolution (SAFIER), or ArF plasma processing is applied to a photoresist pattern.
>
> [0006] However, it is difficult to implement a photoresist pattern having sufficiently large thickness when a short-wavelength light source such as ArF is used. Moreover, since the photoresist pattern does not have sufficiently high resistance to etching, it cannot perform a role as an etching mask very well when an etching depth is deep like in an interlayer insulating layer. To solve the problem, instead of the photoresist pattern, a hard mask layer having superior etching-resistance is used as an etching mask.

Paragraphs [0005]-[0006] of US 2007/0197014. Emphasis added. The inventors of US 2007/0197014 states that it is difficult to implement a photoresist pattern having sufficiently large thickness when a short-wavelength light source such as ArF is used by using RELACS. US

2007/0197014 supports that one skilled in the art understood that it is difficult to apply an ArF laser as a light source to the RELACS technology.

(f) US Patent No. 7,361,448

US Patent No. 7,361,448 was filed on October 28, 2004 by Koji Nozaki; Takahisa Namiki and Miwa Kozawa. US Patent No. 7,361,448 was assigned to Fujitsu Limited. Koji Nozaki and Miwa Kozawa are also listed as the inventors of the present application (Serial No. 11/283,720). The inventors of US Patent No. 7,361,448 filed a declaration. Thus, the statement in the specification of US Patent No. 7,361,448 is true. The Inventors of US Patent No. 7,361,448 states as follows:

> For instance, Japanese Patent Application Laid-Open (JP-A) No. 10-73927 disclose a technique which is called RELACS, and can form a fine space pattern by using KrF (krypton fluoride) excimer laser light (wavelength: 248 nm) which is deep ultraviolet light as the exposure light of a resist. In this technique, a resist pattern is formed by exposing a resist (a positive resist or a negative resist) by using a KrF (krypton fluoride) excimer laser light (wavelength: 248 nm) as the exposure light. Thereafter, by using a water-soluble resin composition, a coated film is provided so as to cover the resist pattern. The coated film and the resist pattern are made to interact at the interface thereof by using the residual acid within the material of the resist pattern, and the resist pattern is thickened. (Hereinafter, this thickening of the resist pattern will be referred to upon occasion as "swelling".) In this way, the distance between the resist patterns is shortened, and a fine pattern having the same form as the space pattern is formed.
>
> However, in the case of RELACS, the KrF resist which is used strongly absorbs ArF excimer laser light, since the KrF resist is formed of an aromatic resin composition such as a polyhydroxystyrene resin or the like, and an aromatic ring contained therein allows KrF excimer laser light (wavelength: 248 nm) pass through but absorbs light having a shorter

> wavelength than the KrF excimer laser light, i.e., ArF excimer laser light (wavelength: 193 nm). Thus, the ArF excimer laser light cannot pass through the KrF resist. There is therefore the problem that ArF excimer laser light cannot be used as the exposure light. Moreover, there is a problem in the RELACS technique that the resist swelling agent is effective for thickening (swelling) the KrF resist but not for thickening (swelling) the ArF resist.

Col. 1, line 40 to col. 2, line 10 of US Patent No. 7,361,448. The Japanese patent publication JP 10-73927, discussed in col. 1, lines 60-61, is based on Japanese patent application No. 9-80940, whose foreign priority was claimed in the Ishibashi reference (US Patent 6,579,657). Thus, JP 10-73927 corresponds to Ishibashi reference (US Patent 6,579,657). US Patent No. 7,361,448, thus, supports that JP 10-73927 or the Ishibashi reference (US Patent 6,579,657) discloses a RELACS technique. US Patent No. 7,361,448 supports that in case of RELACS, the KrF resist strongly absorbs ArF excimer laser light, so that ArF excimer laser light cannot be used as an exposure light. US Patent No. 7,361,448 supports that in case of the RELACS technique disclosed in JP 10-73927 or the Ishibashi reference (US Patent 6,579,657), the resist swelling agent thickens or swells a KrF resist but does not thicken or swell an ArF resist.

(iii) In summary, the evidence of record shows as follows:

(a) "Advanced Micro-Lithography Process with Chemical Shrink Technology," was published on January 15, 2001. The authors of this article included Takeo Ishibashi and Toshiyuki Toyoshima, listed as inventors of the Ishibashi reference (US Patent 6,579,657) and Takashi Kanda and Hatsuyuki Tanaka listed as inventors of the Kanda reference

(JP2001-019860). This article supports that the shrinkage performance of the RELACS process largely depends on the resist chemistry used as the underlying layer. *See* Abstract. This article supports that since the RELACS process largely depends on the resist chemistry, the shrinkage performance of a KrF resist does not guarantee the shrinkage performance of a ArF resist. This article supports that without actual experiments, it is unpredictable to one skilled in the art whether a formulated RELACS material is effective to a resist pattern of an ArF resist.

(b) "Below 70nm Contact Hole Pattern with RELACS Process on ArF Resist," was published on June 12, 2003. The authors of this article overlap with the inventors of Ishibashi et al. (U.S. Patent No. 6,579,657) and Kanda et al. (JP 2001-019860). This article supports that as of June 2003, the RELACS^{TM} material did not show satisfactory shrinkage on ArF resist. As of June 2003, the objective of the authors, including Takeo Ishibashi, Toshiyuki Toyoshima and Hatsuyuki Tanaka, was to realize sub-70nm hole pattern formation by using new RELACS^{TM} for ArF resist. This article supports that before this article (published in June 2003), they had not possessed a RELACS^{TM} material which was effective for an ArF resist. This article also supports that a conventional RELACS^{TM} material, such as a commercial product AZ$^{@}$R200 to a KrF resist, is not capable of thickening an ArF resist.

(c) "Newly Developed Resolution Enhancement Lithography Assisted by Chemical Shrink Process and Materials for Next-Generation Devices" was published on June 20, 2006 (published). One of the authors of this article is Takeo Ishibashi who is listed as an

inventor in Ishibashi et al. (U.S. Patent No. 6,579,657). Takeo Ishibashi admitted that the RELACS material specialized in thickening a KrF resist was not suitable for an ArF resist, and developed a new material to be applicable to an ArF resist. *Id.* at page 5354, right col., lines 12-18. This article supports that that a RELACS material for KrF lithography, as disclosed in Ishibashi et al. (U.S. Patent No. 6,579,657), cannot be used on an ArF resist.

(d) US Patent No. 6,486,058 *supra* supports that one skilled in the art, like Jun-Sung Chun, understands that RELACS is the technology developed by Mitsubishi and Clariant. *See* col. 2, lines 20-26 of US Patent No. 6,486,058.

(e) US 2007/0197014 *supra* supports that one skilled in the art, like Jin-ho Jeon et al., considered that it is difficult to apply a short-wavelength light source such as ArF to the RELACS technology. *See* Paragraphs [0005]-[0006] of US 2007/0197014.

(f) US Patent No. 7,361,448 *supra* supports that the Ishibashi reference (US Patent 6,579,657) discloses a RELACS technique. US Patent No. 7,361,448 supports that in case of RELACS, the KrF resist strongly absorbs ArF excimer laser light, so that ArF excimer laser light cannot be used as an exposure light. US Patent No. 7,361,448 expressly states that in case of the RELACS technique as disclosed by the Ishibashi reference (US Patent 6,579,657), the resist swelling agent thickens or swells a KrF resist but does not thicken or swell an ArF resist.

(iv) In view of the above, the evidence of record (Items (a)-(f) *supra*) clearly supports that the RELACS material disclosed in the Ishibashi reference (US Patent 6,579,657) is not enabling on an ArF resist. It is clear that without any basis or possession, Ishibashi et al. merely mentions an ArF eximer laser in col. 6, lines 45-47.

The Examiner states that the disclosure of ArF is enabling since Ishibashi at col. 6 seems to state that the material is capable of being exposed to ArF. Page 4 of the outstanding Office Action. However, as explained above, Takeo Ishibashi admits in 2006 in "Newly Developed Resolution Enhancement Lithography Assisted by Chemical Shrink Process and Materials for Next-Generation Devices" that they had not possessed an invention applicable to an ArF excimer. The inventors of US 2007/0197014 (Item (e) *supra*) supports that one skilled in the art understood that it is difficult to apply an ArF laser to the RELACS technology. The inventors of US Patent No. 7,361,448 (Item (f) *supra*) further supports that in case of the RELACS technique disclosed in the Ishibashi reference (US Patent 6,579,657), the resist swelling agent does not thicken or swell an ArF resist. Therefore, the Ishibashi's disclosure that an ArF eximer laser may be used as a light source (col. 6, lines 45-47) is baseless.

Ishibashi et al. disclose a novolac resist to be exposed to an i-line or g-line (Examples 1-3), and a chemically-amplified resist to be exposed to a KrF excimer light source (Example 4). Ishibashi et al. disclose no Examples of an ArF resist including no phenol resin. A phenol resin is opaque to an ArF light source.

It is well settled that prior art under 35U.S.C. §102(b) must sufficiently describe the claimed invention to have placed the public in possession of it. *In re Sasse, 629 F.2d 675, 681, 207 USPQ 107, 111 (CCCP 1980)*. Such possession is effected if one of ordinary skill in the art could have combined the publication's description of the invention with his own knowledge to make the claimed invention. Accordingly, even if the claimed invention is disclosed in a printed publication, that disclosure will not suffice as prior art if it was not enabling. *In re Donohoe 766 F.2d 531, 226 USPQ 619 (Fed. Cir 1985)*. Mere naming of the ArF excimer as a light source (col. 6, lines 46 of Ishibashi et al.) cannot constitute an enabling description of the light source. *In re Wiggins, 488 F.2d 538, 179 USPQ 421 (CCCP 1973).* The materials disclosed by Ishibashi et al. in 1997 are not actually applicable to an ArF resist. Ishibashi et al. did not disclose any second resist material used for an ArF resist. There is no actual data testing ArF resists in Ishibashi et al. The evidence of record shows that since the RELACS process largely depends on the resist chemistry, the shrinkage performance of a KrF resist does not guarantee the shrinkage performance of a ArF resist. *See* the abstract of "Advanced Micro-Lithography Process with Chemical Shrink Technology." Without testing, one skilled in the art cannot find that the material can be applied to an ArF resist. The evidence of record also shows that Ishibashi et al. did not possess the invention to thicken a resist pattern of an ArF resist at the time when Ishibashi's application was filed. Thus, to employ an ArF excimer in col. 6. line 46 of Ishibashi et al. is not enabling. Because the Ishibashi's disclosure of

an ArF eximer laser (col. 6, lines 45-47) is not prior art under 35U.S.C. §102(b), this disclosure should not be a basis to reject under 35U.S.C. §103(a).

(v) Forsberg et al. teach that a reaction product of hydrocarbyl-substituted succinic acid and/or anhydride thereof with a water-dispersible amine terminated poly(oxy-alkylene) is added with a surfactant (col. 2, lines 36-55 of Forsberg '500 patent). Forsberg et al. teach replacing oil-based functional fluids with water-based functional fluids in the field of oil-based lubricants, hydraulic fluids and cutting fluid (col. 1, lines 19-37 of Forsberg '500 patent). It is considered that the surfactant taught by Forsberg et al. is used in order to maintain the dispersion of the components in the composition. The Forsberg et al. do not teach any relevant reaching to apply the invention in forming or thickening a resist pattern. The Forsberg et al. neither teach the use on a resist pattern nor the possibility of thickening a resist pattern. The teaching by Forsberg et al. is to use a surfactant in order to maintain the dispersion of the components in the composition. Forsberg et al. do not teach that Triton X-100 is advantageously included in the composition such as the Ishibashi's second resist material. On the other hand, Ishibashi et al. teach using surface active agents "in order to improve the film forming properties (col. 9, lines 6-7)." The teaching by Forsberg et al. is irrelevant to, and independent from, the Ishibashi's second resist material. Also, Forsberg et al. provides no motivation to add Triton X-100 to the Ishibashi's composition, and therefore, there is no motivation to combine Forsberg et al. with Ishibashi et al.

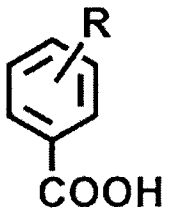
Markovich et al. teach a fluorinated polymeric composition as an insulating sheet used for manufacturing a printed circuit boards and cards. The Markovich' composition includes a fluorinated polymer material, a filler of silica/quarts, and a surface active agent, and is applied to a substrate made of copper, for instance. In Mrkovich et al., the coated material is baked at a specific temperature to remove the surface active agent, to form a film made of the fluorinated polymer and the filler (col.4, line 50 to col. 5, line 5). On the other hand, the Ishibashi's second resist is first applied to a resist pattern and then removed from the resist pattern except for crosslinked portions. Although Markovich et al. uses a term of "film" at col. 5, line 4, the process taught by Markovich et al. is different from the process taught by Ishibashi et al. Thus, the "film-forming properties" taught by Ishibashi at col. 6, line 6-7 do not correspond to the properties to form the film in Markovich et al. Thus, the teaching by Markovich et al. is irrelevant to, and independent from, the Ishibashi's second resist material. The Markovich et al. neither teach the use on a resist pattern nor the possibility of thickening a resist pattern, and therefore, there is no motivation to combine Markovich et al. with Ishibashi et al.

The Examiner states that "Triton X-100 is well known and widely used as non-ionic surfactant, and when employed in the material of Ishibashi et al., the material would thicken the [ArF] resist pattern." Page 4 of the outstanding Office Action. The Examiner seems to consider that Triton X-100 is well known as a non-ionic surfactant, so "FLORADE (a fluorocarbon nonionic surfactant)" (col. 9, lines 8-9 of Ishibashi et al.) could be replaced with Triton X-100 and would thicken an ArF resist pattern. However, as explained above, the

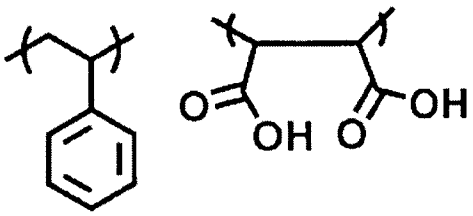
Ishibashi's second resist is irrelevant to, and independent from, the teachings by Forsberg et al. and Markovich et al. "As is clear from cases such as *Adams*, a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." KSR International v. Teleflex, 127 S.Ct 1727, 1741 (2006). "There must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *Id.* Although the Examiner states that "Triton X-100 is well known and widely used as non-ionic surfactant," the Examiner here demonstrates that Triton X-100 is used in the water-based functional fluids as taught by Forsberg et al. or in a printed circuit boards and cards as taught by Markovich et al. The Examiner only demonstrates that Triton X-100 is *independently* known in the prior art. Even if Triton X-100 was well known, being well-known does not support Triton X-100 replaceable with FLORADE (a fluorocarbon nonionic surfactant) as taught by Ishibashi et al. Rather, even if Triton X-100 was well known, but if replacement of "FLORADE (a fluorocarbon nonionic surfactant)" with Triton X-100 successfully resulted in modification of the Ishibashi's second material to accomplishing a thickened ArF resist, this fact supports that the claimed invention has unexpected results. As explained Section (2)(ii)-(iv) *supra*, the Ishibashi's second resist could not thicken an ArF resist, whereas the claimed "resist pattern thickening material is capable of thickening a resist pattern of an ArF resist."

(3) Claims 9, 13 and 31 recite a water-soluble aromatic compound. Currently, the Examiner considers that the styrene-maleic acid copolymer taught by Ishibashi et al. corresponds to the

claimed "water-soluble aromatic compound," recited in claim 9. The Examiner might have considered that styrene-maleic acid copolymer is included in the term "aromatic carboxylic acid compound" recited in claim 13. However, one skilled in the art recognizes that the term "aromatic carboxylic acid compound" requires a structure in which at least one carboxylic acid moiety directly bonds to the aromatic ring. The styrene-maleic acid copolymer does not meet this requirement. *See* the below. One skilled in the art does not classify a styrene-maleic acid copolymer in the category of the aromatic carboxylic acid compounds. Thus, a broadest ordinary meaning of the term does not include the styrene-maleic acid copolymer taught by Ishibashi et al., so claims 9, 13 and 31 are not obvious over the cited references.



aromatic carboxylic acid compound



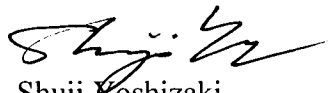
styrene-maleic acid copolymer

(4) In view of above, Applicants submit that the claims, as herein amended, are in condition for allowance. Applicants request such action at an early date. If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned representative at the telephone number indicated below to arrange for an

interview to expedite the disposition of this case. If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP



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Attachment: Petition for Extension of Time
Amendment Transmittal